Lower Middle Miocene Progradational (MM4 P1) Play

Gyroidina "K" through *Amphistegina* "B" biozones
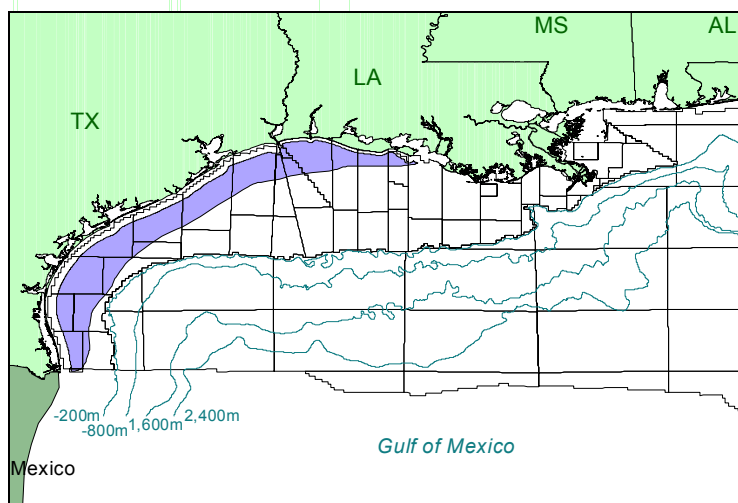

Figure 1. Play location.
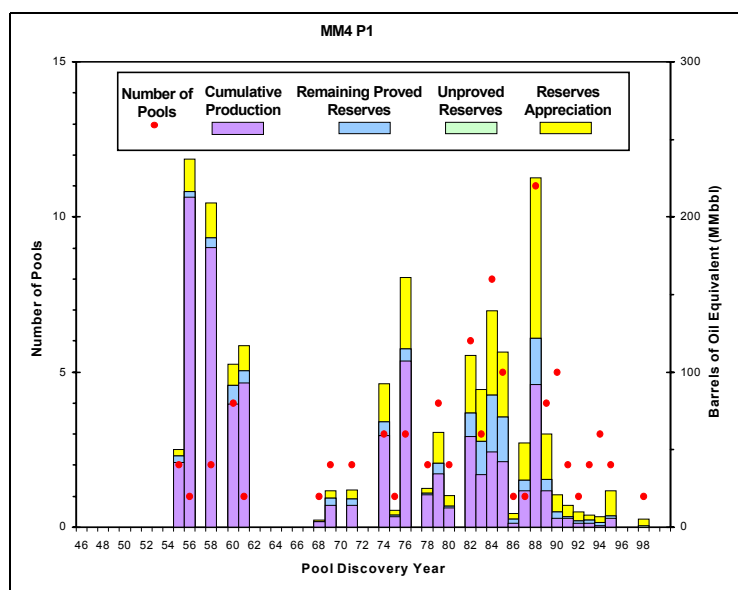

Figure 2. Exploration history graph showing reserves addition and number of pool discoveries by year.

MM4 P1 Play			
85 Pools 474 Sands	**Minimum**	**Mean**	**Maximum**
Water depth (feet)	11	75	212
Subsea depth (feet)	5510	8917	17500
Number of sands per pool	1	6	18
Porosity	15%	27%	33%
Water saturation	16%	31%	53%

Table 1. Pool attributes. Values are volume-weighted averages of individual reservoir attributes.

Play Description

The established Lower Middle Miocene Progradational (MM4 P1) play occurs within the *Gyroidina* "K," *Cristellaria* 54/*Eponides* 14, *Robulus* 43, and *Amphistegina* "B" biozones. This play extends from the South Padre Island Area offshore Texas to the Eugene Island Area offshore Louisiana (figure 1).

Updip and to the northeast, the play continues onshore into Texas and Louisiana. To the southwest, the play extends into Mexican national waters. Downdip of the Eugene Island through High Island Areas, the play grades into the deposits of the Lower Middle Miocene Fan 1 (MM4 F1) play. Although deep-sea fan sediments have not yet been penetrated west of the High Island Area, it is expected that the MM4 P1 play will grade downdip into deep-sea fan sediments in those areas as well.

Play Characteristics

The MM4 P1 play is characterized by sediments deposited in marine bars, delta fringes, distributary mouth bars, and channel/levee complexes. The thickest sand-dominated intervals likely represent stacked facies of multiple episodes of delta-lobe switching and progradation. The MM4 P1 play is also punctuated by well-developed flooding surfaces, of which the *Cristellaria* 54/*Eponides* 14, *Robulus* 43, and *Amphistegina* "B" are the most significant.

Most of the fields in the MM4 P1 play are structurally associated with normal faults and simple anticlines. Other common structures include shale diapir-like bodies, with traps on the flanks of the shale or in sediment drape over the shale, and growth faults with rollover anticlines. Seals are provided by the juxtaposition of reservoir sands with shales,
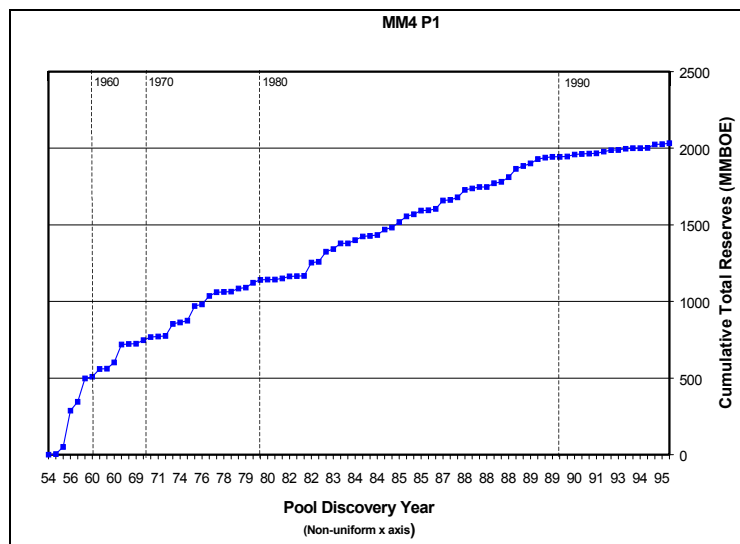
Figure 3. Plot of pools showing cumulative reserves by discovery order. Note the non-uniform x axis.

MM4 P1 Play Marginal Probability = 1.00	Number of Pools	Oil (Bbbl)	Gas (Tcf)	BOE (Bbbl)
Reserves				
Original proved	84	0.120	7.530	1.460
Cumulative production	--	0.101	6.344	1.230
Remaining proved	--	0.020	1.186	0.231
Unproved	1	<0.001	0.006	0.001
Appreciation (P & U)	--	0.035	3.006	0.570
Undiscovered Conventionally Recoverable Resources				
95th percentile	--	0.003	1.073	0.198
Mean	30	0.008	1.250	0.231
5th percentile	--	0.015	1.449	0.266
Total Endowment				
95th percentile	--	0.159	11.615	2.230
Mean	115	0.164	11.792	2.263
5th percentile	--	0.171	11.991	2.298

Table 2. Assessment results for reserves, undiscovered conventionally recoverable resources, and total endowment.

either structurally (e.g., faulting, diapirism) or stratigraphically (e.g., lateral shale-outs, overlying shales).

Discoveries

The MM4 P1 gas play contains total reserves of 0.156 Bbo and 10.542 Tcfg (2.032 BBOE), of which 0.101 Bbo and 6.344 Tcfg (1.230 BBOE) have been produced. The play contains 474 producible sands in 85 pools (table 1; refer to the Methodology section for a discussion of reservoirs, sands, and pools). The first reserves in the play were discovered in 1955 in the Galveston 189 and West Cameron 71 fields (figure 2). Maximum yearly total reserves were added the next year by the discovery of the Vermilion 14 field with 238 MMBOE in total reserves. A secondary peak in maximum yearly total reserves of 225 MMBOE occurred in 1988 with the discovery of 11 pools (figures 2 and 3). Ninety-eight percent of cumulative production and 96 percent of total reserves in the play were from pools discovered before 1990. Since 1990, 16 pools have been discovered, the largest of which contains 22 MMBOE in total reserves. The most recent discovery, prior to this study's cutoff date of January 1, 1999, occurred in 1998.

The 85 discovered pools contain 810 reservoirs, of which 770 are nonassociated gas, 28 are undersaturated oil, and 12 are saturated oil. Cumulative production has consisted of 92 percent gas and 8 percent oil.

Assessment Results

The marginal probability of hydrocarbons for the MM4 P1 play is 1.00. The play contains a mean total endowment of 0.164 Bbo and 11.792 Tcfg (2.263 BBOE) (table 2). Fifty-four percent of this BOE mean total endowment has been produced.

Assessment results indicate that undiscovered conventionally recoverable resources (UCRR) have a range of 0.003 to 0.015 Bbo and 1.073 to 1.449 Tcfg at the 95th and
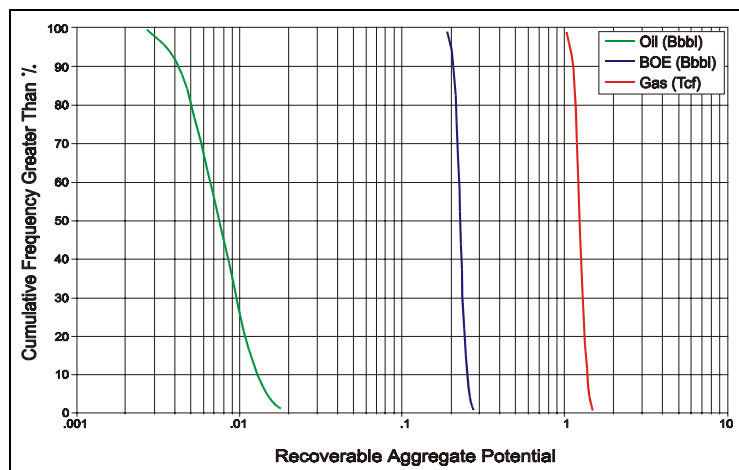

Figure 4. Cumulative probability distribution for undiscovered conventionally recoverable resources.
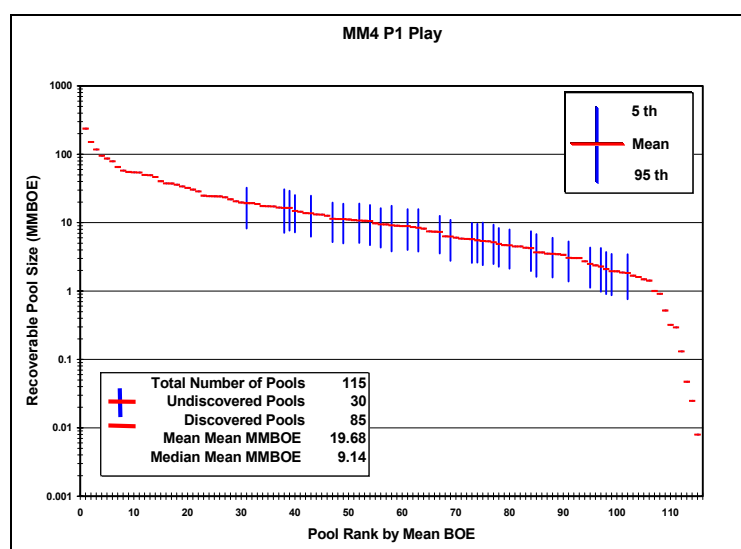

Figure 5. Pool rank plot showing the number of discovered pools (red lines) and the number of pools forecast as remaining to be discovered (blue bars).

5th percentiles, respectively (figure 4). Mean UCRR are estimated at 0.008 Bbo and 1.250 Tcfg (0.231 BBOE). These undiscovered resources might occur in as many as 30 pools. The largest undiscovered pool, with a mean size of 19 MMBOE, is forecast as the 31st largest pool in the play (figure 5). The forecast places the next four largest undiscovered pools in positions 38, 39, 40, and 43 on the pool rank plot. For all the undiscovered pools in the MM4 P1 play, the mean mean size is 8 MMBOE, which is substantially smaller than the 24 MMBOE mean size of the discovered pools. The mean mean size for all pools, including both discovered and undiscovered, is 20 MMBOE.

The MM4 P1 is a supermature play with UCRR contributing 10 percent to the play's BOE mean total endowment.